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AN EVALUATION OF THE IMPACT OF PRENATAL WIC PARTICIPATION ON BIRTH OUTCOMES AND MEDICAID COSTS IN NORTH CAROLINA

by

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ABSTRACT

The purpose of this study was to assess the impact of WIC participation on birth outcomes and Medicaid costs in North Carolina. Medicaid recipients who participated in prenatal WIC services were compared to women on Medicaid who did not receive prenatal WIC services. In order to carry out this evaluation, WIC and other health program data files were linked to 1988 birth certificates. Women on Medicaid receiving prenatal WIC services were found to have substantially lower rates of low birthweight and somewhat lower rates of infant mortality. It was estimated that for each \$1.00 spent on WIC services, savings by Medicaid in newborn medical costs (up to 60 days of age) were \$1.92 for whites and \$3.75 for blacks. Overall, the savings for each dollar spent on WIC were \$2.91.

Among the women who did receive WIC services, those participating longer and more intensely in the program had better birth outcomes. These results strongly suggest that prenatal WIC participation can be effective in reducing low birthweight, infant mortality, and newborn medical care costs among babies born to women in poverty.

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INTRODUCTION

Background

There are many causes of infant mortality. A large part of the problem, however, is a result of low birthweight (less than 2,500 grams). In 1988, eight percent of live births in North Carolina were classified as low birthweight (1). Low birthweight infants are 40 times as likely as normal weight babies to die in the neonatal period (the first 28 days of life). Very low birthweight infants (less than 1,500 grams) are 200 times as likely to die in the neonatal period (2). Poverty, inadequate prenatal care, low education, minority status, maternal age less than 18 or greater than 34, birth out of wedlock, and inadequate prenatal nutrition are all factors which increase the likelihood of low birthweight (1).

North Carolina administers many programs to improve the health of pregnant women and infants. One such program, the Special Supplemental Food Program for Women, Infants, and Children (WIC), provides vouchers for the purchase of specific supplemental foods and infant formula and nutrition education for low-income women and children. Pregnant, breastfeeding, and postpartum women, infants, and children up to age five who are at medical or nutritional risk are eligible. WIC also refers participants to prenatal and well child care. WIC is a nationwide program, funded by the United States Department of Agriculture.

An additional source of revenue in North Carolina is infant formula rebates. The WIC program receives a rebate for each unit of infant formula purchased. These funds are used for program expansion. In 1988, 27,438 pregnant women were enrolled in the North Carolina WIC program. The North Carolina WIC Program served a total of 138,000 women, infants, and children in June 1990 (3).

WIC would be expected to have a significant effect on birth outcomes by enhancing maternal nutrition and thereby increasing infant birthweight. Several studies examining the relationship between prenatal WIC participation and birth outcomes have found positive effects on maternal weight gain, birthweight, and gestational age. However, the studies are hindered by potential bias stemming from self-selection of clients to participate in the program. Compared to non-participants, WIC clients' decisions to participate in the program may be due to heightened "health consciousness." This may confound the

assessment of the effect of participation on health outcomes. In addition, WIC participants by definition are high risk, which complicates the task of defining an adequate control group. Ethical considerations normally preclude random assignment of eligible pregnant women to WIC and non-WIC groups in prospective studies.

Retrospective studies investigating a "dose-response" relationship between WIC participation and birth outcomes (i.e., examining the number of months on WIC as an independent variable) must consider the high correlation of length of gestation and duration of participation. Longer participation should be associated with longer gestation and higher birthweight independent of any WIC effect. Interestingly, different investigations employing various methods to overcome these difficulties have yielded consistent results with respect to low birthweight.

Previous Studies

Edozien et al. (4), in the first major WIC evaluation and a prospective study, found that WIC participation was associated with increased maternal weight gain and infant birthweight. However, this study did not have an adequate control group and did not control for the effect of duration of gestation (5). In a retrospective review of WIC and non-WIC medical and nutrition records, Kennedy et al. (6) found that infants born to mothers on WIC during their pregnancy had significantly higher mean birthweight and a significantly lower incidence of low birthweight than similar non-WIC mothers. The study attempted to control for the bias of self-selection by using as the non-WIC group mothers who were certified for WIC postnatally or who had applied for WIC prenatally but had been unable to get on the program due to a lack of openings.

The only study to randomly assign eligible pregnant women to WIC and control groups, a prospective study by Metcalf et al. (7), found that WIC participation was associated with an increase in the birthweight of infants born to women who were smokers. The investigators considered randomization to be ethical in this case since there was a limited number of openings in the program and exclusion of some women was already necessary.

Two other studies attempted to control for self-selection bias with a different type of retrospective analysis. Kennedy and Kotelchuck (8) took the Kennedy et al. study mentioned above (6) and

re-analyzed the data by matching WIC and non-WIC participants on five maternal characteristics and comparing birth outcomes. Kotelchuck et al. (9) performed a similar analysis matching data from the Massachusetts Birth and Death Registry. Both studies found significant decreases in the incidence of low birthweight among WIC participants. The former study found that WIC participation was associated with a significant decrease in the incidence of fetal deaths. The latter study revealed that participation was associated with a significant decrease in neonatal mortality and a significant increase in length of gestation.

Two studies by Stockbauer (10,11) found that duration of WIC participation (as measured by the cost of redeemed food vouchers) was positively associated with increased mean birthweight and decreased low birthweight rates. However, the methodological difficulties associated with self-selection bias, the confounding of duration of gestation, and variations in the cost of WIC food suggest caution should be exercised in the interpretation of these results.

In cost-benefit analyses, Schramm (12,13) linked birth, WIC, and Medicaid records and found that prenatal WIC participation was associated with a decrease in newborn Medicaid costs of \$75 - \$100 per participant. This reduction was explained in part by a reduction in low birthweight incidence among WIC newborns. Rush (14), in a longitudinal study that was part of the National WIC Evaluation, compared WIC pregnant women to other, low-income women and found increased pregnancy weight gain among WIC mothers as compared to non-WIC mothers.

In a recent multi-state study prepared for the U.S. Food and Nutrition Service (15), it was found that prenatal WIC participation by Medicaid recipients was associated with an increase in both birthweight and gestational age in all five of the study states. Prenatal WIC participation was also associated with substantial savings in Medicaid costs for newborns in the first 60 days after birth. In North Carolina, one of the study states, for 1987 the estimated reduction in newborn Medicaid costs from birth through 60 days associated with prenatal WIC participation was the highest of any of the states at \$744. For every dollar spent on the prenatal WIC program in North Carolina, the associated savings in Medicaid costs were estimated to be \$3.90. These estimated savings associated with prenatal WIC participation are independent of the effects of prenatal care on Medicaid costs.

The present study evaluates the effect of prenatal WIC services on birth outcomes and Medicaid costs in North Carolina in 1988.

METHODS

North Carolina resident live births during calendar year 1988 were examined in order to compare birth outcomes of women who received WIC services in the prenatal period to the outcomes of those who did not. The birth outcomes compared were low birthweight rate (percentage of live births less than 2,500 grams), very low birthweight rate (percentage of live births less than 1,500 grams), infant mortality rate, and newborn medical care costs.

In order to carry out this evaluation, several health program data files were linked to 1988 birth certificate records. Newborn hospital claims paid by Medicaid were matched to the birth records using the baby's name, date of birth, hospital of birth, and other information. Using the baby's Medicaid identification number retained from this step, all claims paid for any service beginning within 60 days of age (inpatient, outpatient, medications, etc.) were extracted and the costs summarized.

Claims paid for maternity care coordination were matched to birth records using the mother's name and date of birth in order to identify births for which this service was received. Prenatal visit records from the public health department client information system in North Carolina were summarized and matched to the birth records on mother's name and date of birth to identify those births where prenatal clinic care was received in health departments. Finally, WIC records were matched to the birth records using mother's name and date of birth in order to identify women receiving WIC services during the prenatal period. Women with one or more prenatal WIC visits were counted as WIC participants.

The primary comparison of birth outcomes between women on WIC and those not on WIC was made within the group of Medicaid births (identified by a matching Medicaid newborn hospital claim), since economically this group is relatively homogeneous. All women on Medicaid giving birth in 1988 had family incomes below 100 percent of the federal poverty level. Births with no prenatal care were excluded, since almost all of these would fall in the non-WIC group and thus bias the results. Simple comparisons of percentages and rates were supplemented by a logistic regression analysis. This analysis assessed the association of WIC participation and

birth outcomes, statistically controlling for differences between the groups in marital status, education, age, race, quantity of prenatal care, smoking, medical risk, and other measurable risk factors.

Average newborn costs for medical care beginning within 60 days of age were compared for the women on Medicaid enrolled and not enrolled in WIC to assess the association of WIC participation and morbidity in early infancy. The difference in average costs between the WIC and non-WIC groups was divided by an estimated average program cost per WIC participant in order to derive a benefit/cost ratio. The program cost was calculated as the total value of all food vouchers redeemed during the prenatal period (process for deriving this information described below) plus an administrative cost estimated as approximately \$8 per participant per month.

An examination of the level of WIC participation determined whether a "dose-response" relationship exists between participation level and birth outcomes. Level of participation was measured in two ways: 1) months of participation in WIC during the prenatal period (four or more versus less than four);

and 2) number of WIC vouchers redeemed as a percentage of the number of redeemed vouchers expected based on the length of time the mother was on WIC during her pregnancy (90 percent or more versus 89 percent or less). This second measure controls for the confounding effect of duration of gestation since the percentage of expected vouchers redeemed will not be biased by gestational age. These measures were derived through matching the WIC birth records identified previously back to WIC participation and redemption data files in order to determine date of entry into WIC for the current pregnancy and number and dollar value of food instruments redeemed during the pregnancy.

RESULTS

Table 1 shows that WIC enrollment was associated with reduced rates of low birthweight and infant mortality, though the association was not statistically significant for infant mortality. These associations were more pronounced in the black* Medicaid population, which is at a higher risk for poor birth outcomes. Other studies have found a stronger relationship between WIC participation and birth outcomes for blacks than for whites (10,11).

TABLE 1						
Low birthweight and infant mortality by race and WIC participation. North Carolina Medicaid births, 1988. Births with no prenatal care are excluded.						
	WHITE			BLACK		
	WIC	Non-WIC	P Value Diff.	WIC	Non-WIC	P Value Diff.
Percent < 2,500 Grams	8.37	10.75	< .001	11.64	16.91	< .001
Percent < 1,500 Grams	1.38	2.46	.001	1.78	4.14	< .001
Infant Death Rate	12.8	13.4	.83	13.7	16.6	.23
Number of Births	6,084	2,608		10,093	3,558	

*Data shown are actually for births for all races other than white, about 93 percent of which are black in North Carolina.

Women on WIC and not on WIC who were neither Medicaid nor health department patients are compared in Table 2. In this comparison, many of the women in the "non-WIC" group are well above the poverty level, while all of the women on WIC qualify for the program by having family incomes below 185 percent of poverty and being at nutritional risk. In spite of this difference in economic level, the WIC women generally have better birth outcomes, the exceptions being white low birthweight and white infant mortality. Black women in this group who are on WIC do consistently better than those not on WIC. The only statistically significant differences are in low and very low birthweight for blacks. These improved WIC birth outcomes, even in comparison to generally non-indigent women, further suggest that the WIC program favorably impacts low birthweight and infant mortality in North Carolina.

The results of a logistic regression analysis of the 1988 Medicaid births, including odds ratios (O.R.) and p values, are shown in Table 3. Controlling for sociodemographic and medical variables, women on Medicaid who were not on WIC were found to be 1.45 times as likely as their WIC counterparts to have a low birthweight baby, and 2.15 times as likely to have a very low birthweight baby. The odds ratio of 1.15 for infant death was not statistically significant.

Values of the control variables were very similar for the WIC and non-WIC groups, except for receipt of maternity care coordination services, where 30 percent of the women on WIC received this Medicaid service in 1988 compared to 8 percent of the women not on WIC.

TABLE 2

Low birthweight and infant mortality by race and WIC participation. North Carolina non-Medicaid and non-health-department births, 1988. Births with no prenatal care are excluded.

	WHITE			BLACK		
	WIC	Non-WIC	p Value Diff.	WIC	Non-WIC	p Value Diff.
Percent < 2,500 Grams	5.78	5.32	.25	9.08	10.40	.03
Percent < 1,500 Grams	0.67	0.86	.18	1.54	2.64	< .001
Infant Death Rate	10.0	7.5	.14	14.4	16.0	.52
Number of Births	3,586	49,434		3,123	11,034	

TABLE 3

Odds ratios from logistic regression. 1988 North Carolina Medicaid births. Births with no prenatal care excluded. N = 21,900.

RISK FACTOR	OUTCOMES					
	< 2,500 g		< 1,500 g		Infant Death	
	O.R.	p	O.R.	p	O.R.	p
Unmarried	1.06	.23	0.94	.58	0.98	.90
Education <12 years	1.12	.02	0.85	.14	1.01	.92
Age <18 years	1.30	.0001	1.52	.007	1.42	.05
Previous death	1.38	< .0001	1.79	< .0001	1.17	.26
Black	1.64	< .0001	1.49	.0005	1.18	.22
Inadequate prenatal care	1.12	.008	0.94	.49	0.94	.62
Mother smoked	1.58	< .0001	1.02	.82	1.22	.13
>=1 medical risk factor	2.24	< .0001	3.16	< .0001	1.85	< .0001
No maternity care coord.	1.16	.006	1.33	.03	1.18	.26
Not enrolled in WIC	1.45	< .0001	2.15	< .0001	1.15	.29

The cost-benefit analysis (Table 4) revealed that the costs to Medicaid for newborn services beginning in the first 60 days of life were lower for infants born to women who were on WIC during their pregnancies. Furthermore, when the cost to WIC per participant was calculated (taking into account both food cost and administrative cost), it was found that the savings in Medicaid costs far outweighed the costs of WIC services. The benefit/cost ratio was 1.92 for whites and 3.75 for blacks, meaning that for each dollar spent on WIC, the savings to Medicaid were \$1.92 for whites and \$3.75 for blacks. Overall, the savings for each dollar spent on WIC were \$2.91.

The more detailed analysis to determine if there was a "dose-response" relationship between WIC participation and birth outcomes revealed that there were 12,822 women who participated in WIC for less than four months before giving birth. These constituted 46.7 percent of the WIC-enrolled women. There were 14,616 women who participated in WIC for four or more months, or 53.3 percent of all

WIC-enrolled women. A total of 8,670, or 31.6 percent, of the women redeemed less than 90 percent of the WIC food instruments expected based on length of participation ("not full" participants). The number of women redeeming 90 percent or greater of their expected vouchers ("full" participants) was 18,768, or 68.4 percent of all WIC participants.

Tabulations of length of enrollment and degree of WIC participation with birth outcomes are summarized in Table 5. Women who participated in WIC for four or more months had much better birth outcomes than those participating for fewer than four months. Controlling for length of enrollment, women who participated fully in WIC had lower low birthweight rates than the "not-full" participants, though the infant mortality rates for the two groups were the same. These results do suggest a "dose-response" relationship, where a higher level of WIC participation is associated with better birth outcomes.

TABLE 4

Average amount paid by Medicaid for newborn services beginning within 60 days of birth and average cost of WIC services. 1988 North Carolina Medicaid births by WIC participation by race. Births with no prenatal care excluded.

	Newborn Costs		Cost of WIC Services	Benefit/Cost Ratio
	WIC	Not WIC	(food/admn.)	(Col 2 - Col 1 ÷ Col 3)
White	\$1,778	\$2,121	\$179	1.92
Black	\$1,902	\$2,517	\$164	3.75
Total	\$1,856	\$2,350	\$170	2.91

TABLE 5

Low birthweight and infant mortality by length and degree of WIC participation. 1988 North Carolina WIC births.

Participation Length	% < 2,500 g	% < 1,500 g	Infant Death Rate	Number of Births
≥ four months	6.65	.59	8.5	14,616
< four months	11.00	2.09	18.8	12,822
p value for difference	< .001	< .001	< .001	
Degree				
Full	8.21	1.22	13.3	18,768
Not full	9.70	1.44	13.3	8,670
p value for difference	< .001	.14	1.0	

The results for length of participation may be exaggerated by the fact that a woman who delivers prematurely will have a shorter period of WIC participation as a result. Yet analysis of full-term births only (greater than or equal to 37 weeks gestation) also suggests that the WIC women who participated for four or more months had better outcomes than those participating for less than four months: 4.10 versus 5.13 percent under 2,500 grams ($p < .001$ for the difference).

Another way to control for the gestational age bias is to examine outcomes by length of WIC participation as a percent of length of gestation. Comparing births to women who were on WIC for 60 percent or more of their pregnancy to those on WIC for less than 60 percent of their pregnancy revealed the following: 6.74 versus 9.41 percent less than 2,500 grams, 0.88 versus 1.42 percent less than 1,500 grams, and an infant mortality rate of 8.8 versus 14.7. These results also suggest a dose-response effect of prenatal WIC participation.

DISCUSSION

From these results, WIC enrollment appears to be associated with improved rates of low birthweight and infant mortality. Among Medicaid recipients, this pattern is seen in both the white and black populations. In the non-Medicaid/non-health-department population, which is higher-income, the pattern still holds for blacks. Among whites, non-Medicaid/non-health-department women are a low-risk population sociodemographically (by virtue of higher income and education), while those within this population who apply for WIC would tend to be higher risk. Therefore, low birthweight and infant mortality for these whites on WIC may be higher because the non-WIC group is relatively well-off economically. In the Medicaid population, the non-WIC women are probably as economically disadvantaged as the WIC women, since Medicaid eligibility requires a low income. Other studies have shown WIC's effect to be stronger in higher-risk populations.

These results do not control for any confounding variables. The logistic regression did control for many of these factors and found that non-participation in WIC was one of the top four predictors of low birthweight, after medical risk, race, and maternal smoking. This suggests that WIC is effective in decreasing the incidence of low birthweight.

Furthermore, the cost-benefit analysis showed that money invested in WIC can save in newborn Medicaid costs.

Higher levels of WIC participation, both for length of time on WIC and degree of participation, were generally associated with better birth outcomes. This apparent "dose-response" effect strengthens the findings from the WIC/non-WIC comparisons and further suggests that WIC participation is having a beneficial impact on birthweight and infant survival.

This study did not control for possible self-selection of more motivated women into the WIC program, except as this may be reflected in the demographic factors incorporated into the logistic regression analysis. However, comparing birth outcomes by WIC participation among Medicaid recipients only does ensure that the socioeconomic status of each group is similar.

In this study it is difficult to untangle the effects of WIC participation and increased participation in prenatal care. The women on Medicaid who were on WIC had somewhat better quantitative levels of prenatal care compared to those not on WIC (48.4 percent less than adequate care vs. 52.9 percent). The regression analysis controlled for this rather crude dichotomous variable and did show a residual positive effect of WIC. But the relative contribution of WIC participation and prenatal care to better birth outcomes may not be an important practical issue. "Improved prenatal care is both an important goal and an achievement of the WIC program." (9)

CONCLUSION

The results of this study show that prenatal WIC enrollment is strongly related to better low birthweight rates, even after controlling for other important risk factors. An association between WIC participation and reduced infant mortality was also apparent, though weaker. In addition, birth outcomes for women who participated longer and more fully in WIC were better than those for women with less participation. It was found that the costs of prenatal WIC services are more than offset by savings in newborn Medicaid costs.

In summary, this study suggests that participation in WIC during the prenatal period is an important factor in reducing adverse birth outcomes in North Carolina, especially among women in poverty.

REFERENCES

1. North Carolina Division of Statistics and Information Services, Department of Environment, Health, and Natural Resources: North Carolina Vital Statistics 1988.
2. Committee to Study the Prevention of Low Birthweight, Institute of Medicine: Preventing Low Birthweight. Washington, D.C.: National Academy Press, 1985.
3. North Carolina WIC Program Data, 1990.
4. Edozien JC, Switzer BR, and Bryan RB: Medical evaluation of the Special Supplemental Food Program for Women, Infants, and Children. *Am J Clin Nutr* 32:677-692, 1979.
5. Rush D: Is WIC worthwhile? *Am J Public Health* 72:1101-1103, 1982.
6. Kennedy ET, Gershoff S, Reed R and Austin JE: Evaluation of the effect of WIC supplemental feeding on birth weight. *J Am Diet Assoc* 80:220-224, 1982.
7. Metcalf J, Costiloe P, Crosby WM, Dutta S, Sandstead HH, Milne D, Bodwell CE, and Majors S: Effect of food supplementation (WIC) during pregnancy on birth weight. *Am J Clin Nutr* 41:933-947, 1985.
8. Kennedy ET, and Kotelchuck M: The effect of WIC supplemental feeding on birth weight: a case-control analysis. *Am J Clin Nutr* 40:579-585, 1984.
9. Kotelchuck M, Schwartz JB, Anderka MT, and Finison KS: WIC participation and pregnancy outcomes: Massachusetts statewide evaluation project. *Am J Public Health* 74:1086-1092, 1984.
10. Stockbauer JW: Evaluation of the Missouri WIC program: prenatal components. *J Am Diet Assoc* 86:61-67, 1986.
11. Stockbauer JW: WIC prenatal participation and its relation to pregnancy outcomes in Missouri: a second look. *Am J Public Health* 77:813-818, 1987.
12. Schramm WF: WIC prenatal participation and its relationship to newborn Medicaid costs in Missouri: a cost/benefit analysis. *Am J Public Health* 75:851-857, 1985.
13. Schramm WF: Prenatal participation in WIC related to Medicaid costs for Missouri newborns: 1982 update. *Public Health Reports* 101: 607-615, 1986.
14. Rush D, Sloan NL, Leighton J, et al.: Longitudinal study of pregnant women. *Am J Clin Nutr* 48:439-483, 1988.
15. Mathematica Policy Research: The savings in Medicaid costs for newborns and their mothers from prenatal participation in the WIC program. Prepared for U.S. Department of Agriculture, Food and Nutrition Service, October 1990.

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